



Mathematics Teacher Quality and Four Decades of CSEC Mathematics Underachievement in Jamaica: Reconsidering the Teacher-Quality Explanation of a Persistent National Dilemma

Paul Andrew Bourne¹, PhD, DrPH

¹Assistant Professor, University of the Commonwealth Caribbean, Kingston, Jamaica, WI.

Abstract

Mathematics achievement has remained one of the most persistent challenges confronting Jamaica's secondary education system, despite repeated curriculum reforms, professional-development programmes, mathematics coaches, specialist-teacher initiatives and substantial public investment in education. This study critically examines approximately four decades of Jamaican performance in Caribbean Secondary Education Certificate (CSEC) Mathematics and evaluates the extent to which the quality, preparation, deployment and retention of mathematics teachers help explain the persistence and volatility of these outcomes. Using an integrative historical-policy review, the study synthesises CSEC performance data, national mathematics policy, education-transformation reports, governmental records and empirical scholarship on mathematics teachers and student achievement. The principal research gap arises because Jamaican studies have examined teacher-quality deficiencies, student performance, cognitive-domain weaknesses and individual interventions, but have not sufficiently integrated approximately four decades of examination outcomes with longitudinal changes in mathematics-teacher preparation, specialist supply, migration and institutional reform in one explanatory framework. The evidence suggests that mathematics-teacher quality is an important component of the problem, particularly because Jamaica has historically deployed substantial numbers of teachers without full mathematics specialisation and has repeatedly lost qualified mathematics educators, but CSEC underachievement cannot be attributed to teachers alone because foundational numeracy, socioeconomic inequalities, student selection into the examination, school leadership, resources, mathematics anxiety, curriculum-examination alignment and pandemic-related learning loss also affect outcomes. The study develops a **Mathematics Teacher Quality-Achievement Continuum Framework** and argues that Jamaica's four-decade dilemma is best understood not as evidence that its mathematics teachers are uniformly poor, but as evidence that the education system has not yet succeeded in ensuring that every student receives sustained access to appropriately qualified, mathematically knowledgeable,

pedagogically capable and institutionally supported mathematics teaching from the primary grades through CSEC.

Keywords: Jamaica; CSEC Mathematics; mathematics teachers; teacher quality; mathematics achievement; teacher migration; mathematics education; pedagogical content knowledge; educational reform; Caribbean education

Introduction

Mathematics occupies a strategic position in national development because competence in quantitative reasoning provides foundations for science, technology, engineering, finance, computing, economics and numerous forms of contemporary employment. At the individual level, mathematics certification also functions as an important gateway to further education and occupational opportunities, particularly in education systems where passes in mathematics are routinely required for tertiary matriculation and professional employment. Jamaica has consequently invested considerable attention in improving mathematics education through curriculum reform, teacher education, coaching, professional development and national mathematics policies (Ministry of Education [MOE], 2013). Nevertheless, mathematics has remained one of the weakest major subjects in the CSEC examination, creating recurrent national concern about the capacity of the school system to prepare students adequately for advanced study and a technologically changing economy. The persistence of the problem is especially notable because poor performance has survived changes in governments, curricula, teacher-training arrangements, school structures and educational interventions. Understanding the dilemma therefore requires analysis extending beyond individual examination years towards the institutional history of mathematics teaching and learning.

The historical pattern is neither one of uninterrupted deterioration nor one of sustained progress. Available national data show periods of severe underachievement, intermittent improvement and subsequent reversal, including the rise from approximately 37-42% passes in the early 2010s to 62% in 2015, followed by later declines and substantial pandemic-era disruption (Jamaica Information Service [JIS], 2016; MOE, 2013). In 2021, only 38.2% of Jamaican public-school candidates obtained Grades I-III compared with 61.2% in 2020 and 54.6% in 2019, demonstrating how rapidly national outcomes can change (JIS, 2021). Performance remained weak in 2024, when 39% of public-school candidates passed Mathematics, and the all-Jamaica figure was 33.4%, before public-school performance improved to approximately 44% in 2025 (JIS, 2024; Ministry of Education, Skills, Youth and Information [MESYI], 2025). These patterns establish the existence of a persistent national problem while simultaneously cautioning against explanations assuming that teacher quality or student ability remains constant over time. A satisfactory explanation must account for both chronic weakness and substantial year-to-year variation.

Teacher quality is one of the most plausible explanations because mathematics is unusually sensitive to teachers' content knowledge and their ability to represent abstract concepts in forms students can understand. Research beyond Jamaica demonstrates that teachers' mathematical knowledge for teaching is positively associated with student achievement, particularly where

teachers possess both substantive mathematical understanding and pedagogical knowledge specific to the discipline (Ball et al., 2008; Hill et al., 2005). Jamaican evidence similarly identifies teacher certification, mathematics specialisation, professional development, working conditions, instructional resources and teacher preparation among factors perceived to influence CSEC Mathematics outcomes (Crossfield & Bourne, 2017). Yet poor examination performance cannot itself be treated as evidence that teachers are deficient because student outcomes are also influenced by earlier learning, socioeconomic circumstances, attendance, motivation, school resources and examination participation. Teacher quality must therefore be conceptualised as one mechanism operating in a wider educational production system. This paper examines how important that mechanism appears to have been over approximately four decades.

Statement of the Problem

The central problem is that Jamaica has experienced persistent mathematics underachievement despite repeated recognition of the problem and repeated policy attempts to correct it. Government records indicate that the proportion of candidates passing CSEC Mathematics remained low throughout much of the 2000s, ranging from approximately 23% to 45% during 2001-2011 (MOE, 2013). National interventions subsequently contributed to periods of substantial improvement, with passes increasing for three consecutive years before reaching approximately 62% in 2015 (JIS, 2016). However, the improvement was not sustained, and the pass rate fell sharply in 2016 while later years continued to show substantial volatility (Ministry of Education, Youth and Information [MOEYI], 2016). This inability to convert episodic gains into stable national achievement is arguably more important than the result of any single examination year. The persistent dilemma therefore concerns not simply low scores but the fragility of improvement.

Teacher supply has developed alongside this achievement problem in ways that require critical examination. In 2016, the Ministry reported that only about 22% of approximately 1,800 mathematics teachers deployed in the secondary system were fully qualified to teach Mathematics, meaning that many individuals teaching the subject lacked the degree-level mathematics specialisation expected by national policy (JIS, 2016). Another governmental account based on the 2013/2014 census stated that only 207 of 1,784 mathematics teachers were fully qualified to teach Mathematics through Grade 11, while an estimated 111 fully qualified mathematics teachers left the system in 2015 (MOEYI, 2016). By 2017, the proportion of fully qualified mathematics teachers had reportedly improved to approximately one-third, but this still meant that specialist expertise was far from universal (JIS, 2019). The persistence of weak achievement alongside limited specialist-teacher supply suggests a plausible relationship requiring systematic investigation. However, association cannot establish causation because the least-qualified teachers may also be concentrated in schools educating the most disadvantaged students.

Research Gap

A growing Jamaican literature has examined different components of mathematics underachievement, but these components have remained insufficiently integrated. Crossfield and

Bourne (2017) surveyed Jamaican CSEC Mathematics teachers and identified teacher certification, lack of mathematics specialisation, professional-development limitations, socioeconomic conditions, student preparation, resources and leadership among important factors affecting mathematics teaching and achievement. George (2023) moved beyond pass-fail classifications by examining the knowledge, comprehension and reasoning profiles of almost 70,000 Jamaican public-school candidates across several CSEC examination years, finding systematic differences across cognitive domains. National policy documents have separately documented examination trends, teacher requirements and interventions designed to improve mathematics education (MOE, 2013). Government reports have also documented teacher migration and shortages, while the Jamaica Education Transformation Commission (JETC, 2021) identified continuing shortages of quality STEM teachers. What remains lacking is an integrated historical analysis linking these teacher-quality and supply problems to approximately four decades of CSEC Mathematics outcomes.

A second research gap concerns the conceptualisation of teacher quality itself. Jamaican public discourse frequently interprets weak Mathematics results as an indicator of poor teaching, but this inference confuses teacher effects with student, school and system effects. International research distinguishes formal qualifications from mathematical content knowledge, pedagogical content knowledge, instructional effectiveness and actual value added to student learning (Ball et al., 2008; Darling-Hammond, 2000; Hill et al., 2005). Jamaica's National Mathematics Policy likewise establishes formal expectations concerning mathematical credits and teacher preparation, yet possession of qualifications cannot guarantee that classroom instruction produces conceptual understanding (MOE, 2013). Conversely, teachers lacking the preferred credential may acquire substantial mathematical and pedagogical expertise through experience and professional development. This paper addresses the gap by evaluating teacher quality as a multidimensional construct rather than equating it with certification alone.

A third gap concerns temporal persistence. Much Jamaican mathematics research is cross-sectional or examines relatively short periods, making it difficult to distinguish temporary examination fluctuations from structural conditions. George (2023), for example, provides a detailed analysis of 2015, 2016, 2018 and 2019 outcomes, while Crossfield and Bourne (2017) provide rich teacher-level perceptions but not a four-decade longitudinal explanation. The national Mathematics Policy supplies historical examination data for 2001-2011, yet predates the pandemic and contemporary teacher shortages (MOE, 2013). The JETC report provides a systemic diagnosis but does not reconstruct the longer relationship between teacher quality and CSEC Mathematics performance (JETC, 2021). The current study therefore contributes a historical synthesis designed to determine which problems have changed and which have remained remarkably persistent.

Research Aim and Questions

The primary aim of this study is to critically examine the relationship between mathematics teacher quality and Jamaica's persistent CSEC Mathematics performance dilemma over approximately four decades. The first research question asks how CSEC Mathematics outcomes have changed across the period and whether the long-term pattern is best characterised as

improvement, stagnation or volatility. The second examines how the qualifications, mathematical specialisation, pedagogical knowledge and professional development of Jamaican mathematics teachers have influenced the quality of instruction. The third investigates the consequences of teacher migration, attrition and uneven deployment across schools for sustained mathematics achievement. The fourth examines competing explanations involving foundational numeracy, school type, socioeconomic conditions, student participation, resources and cognitive demands. The final question asks what reforms are required to transform periodic improvements into sustained national mathematical competence.

Theoretical Framework

The study is grounded first in the concept of **mathematical knowledge for teaching**, which distinguishes knowing mathematics from knowing how to teach mathematics effectively. Ball et al. (2008) argue that mathematics teachers require specialised forms of knowledge enabling them to interpret students' errors, select useful examples, represent mathematical ideas and explain why procedures work rather than simply reproduce correct answers. Hill et al. (2005) found that teachers' mathematical knowledge for teaching was positively associated with gains in student mathematics achievement, strengthening the argument that disciplinary expertise possesses educational consequences. This perspective is particularly relevant in Jamaica because national policy has historically allowed mathematics instruction to be delivered in environments where substantial numbers of teachers lacked full mathematics specialisation (JIS, 2016; MOE, 2013). A teacher may possess a general education qualification while lacking sufficient depth in algebra, geometry, statistics or mathematical reasoning to diagnose students' conceptual misconceptions. The framework therefore treats subject-specific knowledge as a central component of teacher quality.

The second theoretical component is Shulman's (1986) concept of **pedagogical content knowledge**, which explains why subject knowledge alone is insufficient. Effective mathematics teachers must understand which representations make difficult concepts accessible, how misconceptions develop and which sequences of examples support conceptual progression. A mathematically sophisticated graduate can consequently remain an ineffective teacher if unable to translate disciplinary expertise into explanations suitable for adolescents with different levels of prior knowledge. This distinction is particularly important for interpreting Jamaican examination results because students frequently demonstrate greater success with mathematical knowledge than with higher-level comprehension and reasoning (George, 2023). A system emphasising procedural instruction may therefore produce students capable of reproducing familiar algorithms without adequately transferring mathematics to unfamiliar problems. Teacher quality in the present study consequently incorporates the ability to generate conceptual understanding and reasoning rather than examination rehearsal alone.

The third component is an **educational production-function perspective**, in which student achievement is treated as the cumulative result of student, family, teacher, school and system-level inputs. Teacher quality matters in this framework, but it does not operate independently of prior achievement, socioeconomic circumstances, attendance, resources, leadership and peer effects. This approach guards against the ecological error of attributing national examination

outcomes directly to teachers when multiple educational inputs vary simultaneously. It is particularly relevant to Jamaica because students arrive at secondary school with highly unequal levels of foundational numeracy, while schools differ markedly in resources, academic intake and teacher availability (JETC, 2021). Mathematics achievement at Grade 11 therefore reflects years of accumulated learning rather than exclusively the work of the teacher assigned during the CSEC year. The theoretical model accordingly treats teachers as important but embedded contributors to a cumulative mathematics-learning trajectory.

These perspectives are integrated in the proposed **Mathematics Teacher Quality-Achievement Continuum Framework**. The framework begins with teacher recruitment and mathematical preparation, moves through deployment, pedagogical content knowledge, classroom instruction and professional support, and culminates in student mathematical knowledge, comprehension, reasoning and examination performance. Teacher migration and attrition interrupt the continuum by removing experienced specialists, while weak school leadership and inadequate resources can reduce the effectiveness of otherwise qualified teachers. Student foundational knowledge enters the framework as a prior condition affecting how much teachers can accomplish during secondary education. Examination outcomes are therefore interpreted as downstream indicators of the entire continuum rather than direct measures of teacher competence. The framework predicts that sustainable improvement requires strength at every stage rather than isolated examination preparation.

Method

This study employs an **integrative historical review and policy-analysis design** to examine Jamaican mathematics-teacher quality and CSEC Mathematics achievement over approximately four decades. The approach is appropriate because no single longitudinal dataset contains teacher qualifications, teacher migration, school-level instructional processes and national CSEC outcomes throughout the entire period. Evidence was therefore triangulated from Ministry of Education reports, the National Mathematics Policy Guidelines, CSEC performance data, Jamaica Education Transformation Commission documents, peer-reviewed mathematics-education research and official governmental statements. The analysis focuses principally on the period from the mid-1980s through 2025, while earlier educational evidence is used where necessary to contextualise long-term patterns. Historical statistics were treated cautiously because definitions of examination populations, school sectors and candidate cohorts have not remained completely uniform across all sources. The study emphasises broad patterns and documented mechanisms rather than implying perfect comparability between every annual percentage.

A directed thematic analysis was used to organise evidence around six teacher-quality categories: formal qualification, mathematics specialisation, mathematical content knowledge, pedagogical content knowledge, professional development, and retention or deployment. Student and school factors were coded separately to prevent teacher-related explanations from absorbing variables that properly belong elsewhere in the educational system. Examination evidence was categorised by year, pass rate, candidate population where known and major contemporaneous policy intervention. Particular attention was given to turning points such as the severe 2004

performance, the sustained improvement between 2012 and 2015, the subsequent decline, and pandemic-era disruption. Counter-evidence was retained deliberately, including school-level cases in which structured instructional interventions produced substantial improvement despite wider systemic weakness. The methodology therefore seeks explanation rather than confirmation of a predetermined claim that teachers are responsible for poor CSEC outcomes.

Four Decades of Mathematics Performance

Historical evidence demonstrates that weak Mathematics outcomes predate the contemporary teacher-shortage debate. Compilations using Jamaican education statistics report Mathematics pass rates of approximately 40.7% in 1984 and 23.6% in 1994, indicating that severe underachievement was already present before the major policy interventions of the twenty-first century. By 2004, national policy data recorded a pass rate of approximately 23%, one of the lowest points in the modern CSEC series (MOE, 2013). Performance improved unevenly thereafter, reaching approximately 40-45% in several years of the late 2000s and early 2010s. The substantial increase to 55.5% in 2014 and 62% in 2015 showed that weak performance was not immutable (JIS, 2016). The subsequent reversal demonstrates, however, that episodic improvement has proved easier than sustainable transformation.

Table 1 reveals three important features of the Jamaican mathematics dilemma. First, weak Mathematics outcomes are structurally persistent because low pass rates appear in each of the four decades represented. Second, substantial improvement is possible, as demonstrated particularly by the movement from approximately 37.5% in 2012 to 62% in 2015. Third, gains have repeatedly proved fragile, with later declines occurring despite the persistence of many interventions introduced during improvement periods. These observations challenge both fatalistic explanations and simplistic claims that a single reform can permanently resolve the problem. The central analytical question therefore becomes why the system can produce improvement temporarily but has difficulty institutionalising it.

Table 1: Selected Indicators of Jamaican CSEC Mathematics Performance Across Approximately Four Decades

Year	Approximate pass rate	Population/ qualification note	Interpretive significance
1984	40.7%	Historical Jamaican examination statistics	Weak performance evident early in the period
1994	23.6%	Historical Jamaican examination statistics	Severe deterioration by the mid-1990s
2004	23-24%	Public-school/national policy series	Major low point prompting intervention
2009	40.9%	Jamaican public-school candidates	Recovery but still majority non-passing
2012	37.5%	Public-school candidates	Beginning point of later improvement sequence
2013	42.2%	Public-school candidates	Improvement
2014	55.5%	Public-school candidates	Strong increase

2015	62.0%	Public-school candidates	High point in recent pre-pandemic series
2016	47.7%	Public-school candidates	Sharp decline after three-year improvement
2019	54.6%	Public-school candidates	Moderate recovery
2020	61.2%	Public-school candidates	High but examination circumstances affected by pandemic period
2021	38.2%	Public-school candidates	Severe pandemic-era decline
2024	39.0%	Public schools	Persistent weakness
2024	33.4%	All Jamaica	Shows effect of population definition
2025	44.0%	Jamaican public-school reporting	Improvement, but below 2019 level

Note. Historical percentages are not perfectly comparable because examination populations, reporting practices and school-sector coverage vary across sources. The table is therefore intended to demonstrate long-run direction and volatility rather than a single uninterrupted statistical series (JIS, 2016, 2021, 2024; MESYI, 2025; MOE, 2013).

Revised Quantitative-Historical Methods

The quantitative component of this study employs a longitudinal interrupted-trend design to examine changes in Jamaican CSEC Mathematics performance alongside major mathematics-teacher policy interventions between 2001 and 2025. The principal outcome is the percentage of candidates attaining Grades I-III in CSEC Mathematics, with annual results reconstructed from Ministry of Education policy documents and Jamaica Information Service examination reports (Jamaica Information Service [JIS], 2014, 2015, 2017, 2018, 2019, 2021, 2022; Ministry of Education [MOE], 2013; Ministry of Education, Skills, Youth and Information [MESYI], 2025). The 2001-2011 series is taken from the National Mathematics Policy, which reports both the number sitting and the number obtaining Grades I-III and shows candidate pass rates ranging from 23% to 45% during the period (MOE, 2013). The later series is reconstructed from annual official releases, prioritising public-school results where that population is explicitly identified and retaining source notes where reporting conventions differ. The analysis does not treat the resulting dataset as perfectly homogeneous because candidate coverage, examination-entry practices and reporting populations have changed over time, particularly during and after the COVID-19 pandemic. Accordingly, the quantitative results are interpreted as evidence of long-run patterns and possible structural changes rather than as a causal time-series experiment with completely invariant measurement.

The historical component extends the interpretation backwards into the 1980s while keeping those observations analytically separate from the main statistical series. World Bank data show that only 30% of Jamaican entrants attained Grades I-II in CXC Mathematics in 1984 and 22% did so in 1989, demonstrating that serious mathematical underachievement was already established decades before contemporary reforms (World Bank, 2000). These observations cannot be merged directly with the later Grades I-III series because the outcome definition differs, but they establish the longer historical continuity necessary for a four-decade

interpretation. The quantitative analysis therefore uses 2001-2025 for in-series comparisons and 1984-1989 evidence as contextual confirmation that the phenomenon did not originate in the twenty-first century. This decision reduces the risk of creating artificial trends by combining non-equivalent assessment measures. The study consequently favours comparability over the appearance of a longer uninterrupted numerical series.

Three analytically meaningful periods are compared in the reconstructed series. The **pre-intensive reform period, 2001-2012**, precedes the strongest phase of the National Mathematics Programme and the 2013 National Mathematics Policy, while the **reform and expansion period, 2013-2019**, encompasses mathematics coaching, specialist-teacher initiatives, teacher scholarships and strengthened policy standards (JIS, 2016; MOE, 2013). The **pandemic and recovery period, 2020-2025**, captures severe instructional disruption, post-pandemic learning recovery and renewed specialist-teacher intervention, with 2023 interpreted cautiously because CXC examination breaches resulted in modified grading procedures that make direct comparison problematic (JIS, 2024). Descriptive statistics include period means, ranges, standard deviations and estimated annual linear trends. Changes are interpreted alongside documented teacher-policy developments rather than assumed to have been caused by them. This mixed historical-quantitative approach enables the study to ask whether periods of stronger teacher support correspond with materially different national achievement trajectories while preserving appropriate causal caution.

Longitudinal CSEC Mathematics Dataset

Table 2: Reconstructed CSEC Mathematics Pass Rates in Jamaica, 2001-2025

Year	Mathematics pass rate (%)	Principal source/interpretive note
2001	29.0	National Mathematics Policy
2002	36.0	National Mathematics Policy
2003	36.0	National Mathematics Policy
2004	23.0	National Mathematics Policy; lowest point in the official 2001-2011 series
2005	40.0	National Mathematics Policy
2006	36.0	National Mathematics Policy
2007	35.0	National Mathematics Policy
2008	43.0	National Mathematics Policy
2009	41.0	National Mathematics Policy
2010	45.0	National Mathematics Policy
2011	40.0	National Mathematics Policy
2012	37.5	Ministry/JIS reporting
2013	42.2	Beginning of major improvement sequence
2014	55.5	Large improvement during national intervention period
2015	62.0	Public-school candidates; recent high point
2016	47.7	Sharp reversal
2017	50.2	Partial recovery

2018	57.8	Public-school candidates
2019	54.6	Public-school candidates
2020	61.2	Pandemic-era examination context
2021	38.2	Severe pandemic-era decline
2022	37.2	Continued weakness
2023	44.7*	Interpret cautiously because of CXC examination breaches and modified grading.
2024	39.0	Public-school candidates
2025	44.0	Public-school candidates

Note. The 2001-2011 data are taken directly from the Ministry of Education's National Mathematics Policy, which reports Grades I-III among candidates sitting the examination (MOE, 2013). Later figures are drawn from official Ministry and JIS reporting, with population differences noted where possible. The 2023 result should not be used as a straightforward year-to-year comparison because the Ministry itself subsequently advised caution owing to examination breaches and modified grading procedures.

Descriptive Results

The reconstructed series provides strong evidence that Jamaica's mathematics problem is persistent but not stationary. Across the 24 reasonably comparable observations used for the principal analysis, excluding the anomalous 2023 examination year, the average CSEC Mathematics pass rate was approximately **43.0%**, with a standard deviation of approximately 9.8 percentage points. The observed values ranged from 23% in 2004 to 62% in 2015, meaning that the distance between the weakest and strongest outcomes was approximately 39 percentage points. Such variation is too large to support the proposition that Jamaican students possess a fixed inability to perform Mathematics successfully. Instead, national achievement appears highly responsive to changing educational, institutional and external conditions. The central analytical challenge is therefore explaining why substantial improvements have repeatedly emerged but have proved difficult to sustain.

The pre-intensive reform period from 2001 to 2012 recorded an average Mathematics pass rate of approximately **36.8%**. Performance during this period ranged from 23% to 45%, and a simple linear trend indicates modest improvement of approximately one percentage point annually across the period. However, even the upper end of the range meant that more than half of candidates failed to achieve Grades I-III in most years, while the National Mathematics Policy noted that only approximately 10-21% of the entire eligible age cohort attained those grades (MOE, 2013). The policy document also reported weak Grade 3, Grade 4 and GSAT Mathematics outcomes, indicating that secondary-school underachievement was embedded in weaknesses arising considerably earlier in the education pipeline (MOE, 2013). These results support the interpretation that Jamaica entered the major reform period with both a teacher-quality problem and a substantial accumulated student-learning problem. Teacher reform consequently had to improve current instruction while simultaneously compensating for mathematical deficits inherited from earlier schooling.

The 2013-2019 period presents a markedly different pattern, with the average CSEC Mathematics pass rate rising to approximately **52.9%**, more than 16 percentage points above the 2001-2012 mean. During this period, national policy formalised minimum qualifications for mathematics teachers, the Ministry expanded mathematics coaching and specialist support, and scholarship programmes were used to increase the future supply of mathematics specialists (JIS, 2016; MOE, 2013). The pass rate increased from 42.2% in 2013 to 55.5% in 2014 and 62% in 2015, providing the clearest sustained national improvement in the reconstructed series (JIS, 2014, 2015). Importantly, the Ministry itself connected this improvement with mathematics specialists, coaches and in-service professional development while simultaneously acknowledging that only approximately 22% of the secondary mathematics teaching workforce was fully qualified at the time (JIS, 2016). The coincidence does not establish causality, but it provides historically consistent evidence that strengthened teacher support occurred during the most substantial national improvement episode.

The 2013-2019 period also demonstrates why a simple before-and-after policy interpretation would be inadequate. Performance declined from 62% in 2015 to 47.7% in 2016 despite the continuation of many mathematics interventions, before recovering to 50.2% in 2017 and 57.8% in 2018 (JIS, 2017, 2018). The 2016 decline coincided with continued concern about insufficient numbers of qualified mathematics teachers and the departure of trained specialists from the education system (JIS, 2016). The Ministry responded with scholarships for approximately 230 student-teachers in Mathematics, Science and technical-vocational fields, including 138 pursuing secondary Mathematics education, alongside additional coaches and leadership development for mathematics departments (JIS, 2016). This sequence supports the paper's proposed concept of **specialist-capacity instability**, whereby national improvement remains vulnerable because qualified teacher supply can be depleted even while professional-development programmes are attempting to strengthen instructional quality. The problem is therefore not simply whether reforms exist but whether sufficient specialist capacity accumulates and remains inside the system.

The pandemic and recovery period present the strongest evidence that teacher quality alone cannot explain national Mathematics outcomes. The official series records a high of approximately 61.2% in 2020 followed by a collapse to 38.2% in 2021 and 37.2% in 2022 (JIS, 2021, 2022). Jamaican mathematics teachers could not plausibly have experienced a national deterioration in professional quality of more than 20 percentage points in one year, making school closures, remote learning, unequal digital access and accumulated learning loss essential explanatory factors. Performance recovered to 39% among public-school candidates in 2024 and 44% in 2025, but the latter remained approximately ten percentage points below the 2019 pre-pandemic level (MESYI, 2025). This pattern demonstrates that teacher effectiveness depends substantially on the instructional environment and students' accumulated opportunity to learn.

Table 3: Period Comparison of CSEC Mathematics Performance

Period	Number of comparable observations	Mean pass rate (%)	Approximate SD	Range (%)	Interpretation
2001-2012	12	36.8	6.0	23.0-45.0	Persistent low achievement before major reform intensification
2013-2019	7	52.9	6.6	42.2-62.0	Substantially higher achievement during strong coaching/specialist-policy period
2020-2025*	5	43.9	10.0	37.2-61.2	High volatility associated with pandemic disruption and incomplete recovery

*2023 excluded from period calculation because of the examination irregularity identified by the Ministry.

The difference between the first two periods is substantively large. Average performance increased from approximately 36.8% during 2001-2012 to 52.9% during 2013-2019, representing an increase of approximately **16.1 percentage points**. This improvement occurred during precisely the period in which Jamaica formalised its National Mathematics Policy and intensified specialist-teacher support, coaching and mathematics-focused professional development (MOE, 2013; JIS, 2016). However, the evidence should be interpreted as **policy-associated improvement rather than a causal treatment effect**, because curriculum changes, student selection, examination difficulty, school interventions and other national developments occurred simultaneously. The subsequent collapse during the pandemic further confirms that improvements produced through teacher reform can be overwhelmed by disruptions occurring elsewhere in the educational production system. The quantitative evidence therefore supports a systems interpretation rather than a single-factor teacher explanation.

Structural Break Interpretation

The most plausible structural break in the pre-pandemic series occurs around **2013-2014**, when national performance shifted from a long-standing range centred largely below 45% into a substantially higher range. Mathematics performance was 37.5% in 2012, increased to 42.2% in 2013, reached 55.5% in 2014 and rose to 62% in 2015 (JIS, 2015; MOE, 2013). The timing overlaps with the National Mathematics Policy, expansion of mathematics coaches and specialists, structured teacher workshops and intensified public-private intervention in mathematics teaching. Insurance-sector-supported teacher workshops, for example, began in 2013, and official reporting noted the sequential national increase from 37.5% to 42.2%, 55.5% and 62% between 2012 and 2015 (MOEYI, 2016). The convergence of policy timing and examination improvement makes this period an important natural historical experiment for future causal investigation. It suggests that Jamaica should study the institutional mechanisms of this period more intensively rather than repeatedly beginning reform from first principles.

A second structural break occurs around **2021**, although this break is clearly associated with an exogenous disruption rather than a teacher-policy reform. The fall from approximately 61.2% in 2020 to 38.2% in 2021 was followed by another low result of 37.2% in 2022, indicating that pandemic-related disruption generated effects extending beyond the first year of school closure (JIS, 2021, 2022). The Ministry subsequently noted that the cohort sitting CSEC Mathematics in 2024 had lost face-to-face instruction during Grades 7 and 8, directly connecting later examination weakness with earlier interrupted learning (JIS, 2024). This reinforces the cumulative-learning argument embedded in the Mathematics Teacher Quality-Achievement Continuum Framework. CSEC performance reflects the entire mathematics-learning history of a cohort rather than simply instruction delivered immediately before the examination.

Teacher Policy Timeline

Table 4: Major Mathematics-Teacher Policy Developments and CSEC Performance Context

Period/intervention	Teacher-quality mechanism	Mathematics outcome context	Analytical interpretation
Early 2000s mathematics/numeracy policy initiatives	Recognition of weak teacher and student mathematical competence	Pass rate falls to 23% in 2004	Establishes severity of structural problem
Mathematics training modules, mid-2000s onward	Structured curriculum sequencing and teacher development	Large improvements documented in selected schools	Suggests sustained teacher support can change school outcomes
National Mathematics Programme	Coaching, specialists, professional development	National improvement begins after 2012	Plausible contribution requiring causal testing
National Mathematics Policy, 2013	Formal standards for qualifications, pedagogy and teacher education	42.2% in 2013; 55.5% in 2014; 62% in 2015	Strongest period-level evidence of policy-associated improvement
Specialist scholarships and additional coaches, 2016 onward	Increase specialist supply and support underperforming schools	Recovery after 2016 decline	Indicates policy response to specialist scarcity
Continued specialist-teacher initiatives, 2017-2019	Increase qualified Mathematics teachers	57.8% in 2018; 54.6% in 2019	Relatively strong pre-pandemic period
COVID-19 disruption, 2020-2022	Reduced instructional continuity and unequal learning access	Fall to 38.2% and 37.2%	Demonstrates importance of non-teacher system conditions

Post-pandemic targeted intervention, 2024-2025	Specialist teachers, camps, targeted school support	Increase from 39% to 44%	Early recovery but below pre-pandemic level
--	---	--------------------------	---

School-level evidence provides an additional form of triangulation supporting the importance of teacher-focused intervention. Meadowbrook High reportedly increased its CSEC Mathematics pass rate from 21.7% in 2004 to 58.2% in 2005, 68.5% in 2007 and 73.3% in 2008 following sustained use of a structured mathematics module accompanied by teacher preparation (JIS, 2011). Gaynstead High similarly moved from approximately 8% in 2005/2006 to 16% in 2007, 34% in 2008, 54% in 2009 and 73% in 2010 (JIS, 2011). These are observational cases rather than controlled experiments, meaning that leadership, student cohorts and other school-level changes may also have contributed. Nevertheless, the magnitude and persistence of the improvements demonstrate that low Mathematics performance is not an immutable property of students attending historically underperforming schools. The evidence strengthens the case for examining teacher learning and instructional organisation as modifiable components of the national problem.

Revised Interpretation of the Research Gap

The quantitative evidence sharpens the study's research gap considerably. The gap is no longer simply that Jamaican scholarship has failed to investigate teacher quality, because Crossfield and Bourne (2017), national policy documents and government reports have already established deficiencies in specialist preparation, professional development and teacher supply. The unresolved scholarly problem is that existing work has not adequately explained the **temporal coexistence of recognised teacher-quality deficiencies, repeated reforms and highly volatile national Mathematics outcomes**. The 2001-2012 average of approximately 36.8%, the 2013-2019 average of approximately 52.9% and the subsequent pandemic-era deterioration demonstrate that national performance changes materially across institutional periods. A useful theory must therefore explain both persistent underachievement and periods in which the same national education system produces dramatically better outcomes. This study addresses that gap by conceptualising mathematics-teaching quality as an accumable but depletable stock of specialist human and institutional capital.

This interpretation moves beyond the question of whether Jamaican mathematics teachers are individually competent. A school system can contain many excellent individual teachers while producing weak national outcomes if insufficient numbers of those teachers exist, if specialists are distributed inequitably, if migration repeatedly removes experienced personnel or if students enter secondary education with severe foundational deficits. Conversely, national improvement can occur when coaching, specialist support and stronger instructional coordination temporarily increase the effective teaching capacity available to schools. The key variable is therefore not simply **individual teacher quality**, but **system-wide access to sustained quality mathematics teaching**. The four-decade dilemma is fundamentally a scaling and sustainability problem. Jamaica has demonstrated repeatedly that mathematical achievement can improve, but it has not yet demonstrated that high-quality mathematics instruction can be institutionalised equitably and retained across generations of students.

Additional Empirical Proposition

The expanded analysis generates a new proposition that can be tested in subsequent research: **CSEC Mathematics performance should increase when the effective density of specialist mathematics teachers rises, but the effect will be moderated by students' prior numeracy and the institutional conditions of schools.** Effective specialist density should therefore be measured not simply as the number of qualified teachers nationally but as the proportion of Mathematics instructional hours delivered by appropriately specialised teachers in each school. The model predicts stronger teacher-quality effects in schools where specialist expertise is sustained across successive grades rather than concentrated only in Grade 11 examination classes. It also predicts diminishing effects where students enter secondary education with very large foundational deficits unless intensive remediation accompanies stronger teaching. Linking teacher administrative records with student longitudinal data would permit direct testing of these propositions. Such work would transform the current historical association into a genuinely causal programme of Jamaican mathematics-education research.

Revised Conclusion

The longitudinal evidence changes the interpretation of Jamaica's Mathematics dilemma from one of simple failure to one of **persistent weakness, demonstrable responsiveness and inadequate institutionalisation.** The average CSEC Mathematics pass rate was only about 36.8% during 2001-2012 but rose to approximately 52.9% during 2013-2019, a period characterised by intensified mathematics coaching, specialist support and formalisation of national teacher-quality standards. The rise demonstrates that Jamaica's mathematics outcomes are capable of substantial improvement, while the subsequent reversal demonstrates that gains are vulnerable when specialist capacity, learning continuity or wider educational conditions deteriorate. The evidence therefore provides qualified support for the teacher-quality hypothesis without legitimising teacher blame. Teacher expertise appears to matter, but its national effect depends on the number, distribution, support and retention of specialists and on the mathematical preparation students bring to their classrooms. Jamaica's four-decade dilemma is consequently not that improvement has never occurred, but that improvement has not yet become a stable property of the education system.

The policy implication is that annual CSEC results should cease functioning primarily as occasions for renewed public alarm and instead become components of a permanent longitudinal mathematics-intelligence system. Jamaica should annually link CSEC outcomes with teacher qualifications, teacher specialisation, school vacancies, coaching exposure, migration, Grade 6 Mathematics proficiency and student socioeconomic characteristics. Such linkage would make it possible to determine whether schools improve because of teacher changes, stronger student intake, additional instructional time or combinations of these factors. It would also permit rigorous evaluation of whether specialist-teacher programmes produce sufficient educational returns to justify expansion. Until these variables are connected longitudinally, national debate will continue to alternate between blaming students, teachers, parents, curricula and examinations without being able to quantify their relative contributions. A Scopus-level research

programme should therefore treat the reconstruction presented here as the starting point for a national linked-data study of mathematics teaching and achievement.

Teacher Qualifications and Mathematics Specialisation

Formal teacher preparation represents one of the strongest areas in which Jamaican evidence supports a teacher-quality explanation. The National Mathematics Policy specifies substantial mathematics-credit requirements for teachers assigned to Grades 7-11 and emphasises that mathematics teachers should be graduates of programmes focused specifically on mathematics education (MOE, 2013). Yet implementation historically lagged well behind the policy ideal, with the Ministry reporting in 2016 that only about 22% of mathematics teachers in the secondary system were fully qualified for the subject (JIS, 2016). The proportion reportedly increased to approximately 33% by the end of 2017, indicating progress but also revealing that two-thirds of the mathematics teaching cohort still did not meet the strongest specialist criterion (JIS, 2019). Such figures make it difficult to dismiss teacher preparation as a peripheral explanation of national Mathematics outcomes.

The distinction between being a trained teacher and being a trained mathematics teacher is crucial. Crossfield and Bourne (2017) observed that teachers sometimes upgraded their academic qualifications in fields other than mathematics while continuing to be assigned Mathematics classes. This practice increases the nominal qualification level of the teaching workforce without necessarily increasing mathematical knowledge for teaching. A general education degree may strengthen pedagogy but cannot automatically provide the algebraic, statistical, geometric and reasoning expertise required to diagnose students' mathematical misconceptions. National statistics reporting the proportion of trained teachers can therefore create an overly optimistic picture if specialisation is not examined simultaneously. Jamaica requires subject-specific teacher-quality indicators rather than system-wide qualification averages alone.

Mathematical Knowledge for Teaching

Content knowledge becomes particularly important where students encounter abstract concepts and unfamiliar problem structures. Ball et al. (2008) distinguish ordinary mathematical competence from specialised knowledge used in teaching, such as evaluating unconventional student solutions or selecting examples that reveal mathematical structure. Jamaican CSEC evidence suggests that many students struggle beyond routine knowledge, making this specialised competence particularly important. George's (2023) analysis found that Jamaican candidates consistently performed strongest in the knowledge domain, followed by comprehension and then reasoning across several examination years. The pattern suggests that students' difficulties are not merely failures to recall mathematics but involve transferring and reasoning with mathematical ideas. Improving teacher quality therefore requires deeper emphasis on how teachers cultivate reasoning and conceptual connections.

This finding also raises questions concerning classroom pedagogy. Examination-oriented systems can encourage procedural teaching because teachers face pressure to cover syllabuses and improve pass rates in limited instructional time. Procedural competence is necessary, but students

who learn mathematics predominantly through memorised algorithms may struggle when questions require unfamiliar applications or justification. George's (2023) cognitive-domain findings are consistent with this concern because reasoning performance was systematically weaker than basic knowledge. Teacher professional development should therefore include analysis of student reasoning, misconceptions, problem construction and multiple mathematical representations rather than concentrate exclusively on syllabus coverage. The quality challenge is ultimately about the intellectual character of mathematics instruction rather than credentials alone.

Teacher Migration and the Loss of Specialist Capacity

Teacher migration represents one of the most important mechanisms connecting workforce quality with unstable student outcomes. Jamaica's Education Ministry reported that more than 490 mathematics and science teachers were estimated to have left the secondary system between the 2014 and 2015 academic years, with destinations including North America, Britain, other Caribbean territories and countries farther afield (JIS, 2016). The departure of qualified specialists has effects exceeding the numerical vacancy because experienced teachers frequently serve as heads of departments, mentors, examination specialists and sources of institutional memory. Schools replacing them with less-specialised or inexperienced teachers may preserve classroom coverage while experiencing a decline in instructional quality. Migration can therefore produce **hidden deskilling**, in which staffing numbers appear adequate even though the disciplinary expertise represented in those numbers has deteriorated. This mechanism provides a plausible explanation for why improvements associated with teacher support can prove difficult to sustain.

The JETC (2021) confirmed that STEM-teacher attrition remained a national concern and reported consultation evidence describing critical shortages of quality mathematics and science teachers. The Commission noted that teacher losses had accumulated over many years, thereby suggesting that the problem cannot be understood as an isolated 2015 episode. Recruitment programmes consequently operate partly as replacement mechanisms for expertise continuously leaking from the system. Jamaica may therefore train more mathematics teachers without achieving proportional growth in specialist density if qualified teachers leave at similar rates. This creates a human-capital treadmill in which teacher education institutions replace losses rather than deepen system quality. Sustainable Mathematics improvement consequently requires retention to be treated as an instructional reform rather than merely a human-resources issue.

Unequal Teacher Deployment and School-Level Inequality

National teacher-quality averages conceal substantial inequalities among Jamaican secondary schools. More academically prestigious traditional high schools may possess advantages in recruiting and retaining specialist mathematics teachers because of location, institutional reputation, stronger student intake and established departmental structures. Upgraded, rural and socioeconomically challenged schools may face greater difficulty attracting similarly specialised staff, creating unequal opportunities to learn Mathematics. Crossfield and Bourne (2017) identified socioeconomic conditions, leadership, teaching resources and working conditions

alongside certification and specialisation as factors influencing achievement. This means the effect of teacher quality is likely to be conditional on the institutional environment in which teachers work. A highly qualified teacher placed in a poorly resourced and unstable department may not generate the same outcomes as an equivalently qualified teacher working in a well-supported school.

This distributional issue is important because Jamaica's CSEC averages combine schools serving very different student populations. National examination outcomes therefore cannot reveal whether teacher quality is uniformly weak or whether high-quality teaching is unevenly distributed. The policy objective should not merely be to increase the total number of qualified mathematics teachers but to ensure equitable specialist access across schools and geographic areas. Incentives for hard-to-staff schools, housing or transportation assistance, professional advancement and strong departmental leadership could help reduce these inequalities. The JETC's recommendation that incentives be targeted towards underserved geographical and subject areas reflects precisely this concern (JETC, 2021). Teacher quality becomes a national-development issue when students' access to specialist expertise depends substantially on where they attend school.

Foundational Numeracy and the Limits of the Teacher Explanation

Secondary mathematics teachers inherit rather than create all of the mathematical knowledge possessed by Grade 7 students. Jamaica's National Mathematics Policy documented weaknesses in mathematics achievement well before students reached CSEC, demonstrating that the secondary-level problem has deep foundations (MOE, 2013). More recent PEP results similarly show that a substantial share of primary-school students remain below proficiency in Mathematics despite recent improvement (JIS, 2024). Students entering secondary education without secure number sense, fractions, proportional reasoning and elementary algebraic thinking require substantial remediation before they can engage successfully with CSEC content. Secondary teachers are therefore simultaneously expected to repair accumulated learning deficits and deliver a demanding upper-secondary curriculum. Attributing final CSEC failure solely to the Grade 10 or Grade 11 teacher would consequently be analytically indefensible.

Foundational weakness also creates cumulative inequality because mathematics learning is unusually hierarchical. A student who fails to understand fractions may subsequently struggle with ratios, algebraic expressions, equations and probability, producing difficulties that expand as the curriculum becomes more abstract. Teachers working with such students require diagnostic knowledge and differentiated pedagogical strategies rather than ordinary whole-class syllabus delivery. Large classes and examination pressure can make this form of remediation difficult, particularly where teachers simultaneously teach students whose mathematical readiness varies by several grade levels. The quality of secondary mathematics teaching therefore depends partly on the quality of primary mathematics preparation. Jamaica's dilemma must consequently be understood as a **mathematics pipeline problem**, not solely a CSEC-year problem.

The CSEC Participation Problem

Pass rates can also exaggerate or conceal educational performance depending on which students are entered for the examination. Jamaica's National Mathematics Policy showed that the proportion of the entire eligible cohort attaining Grades I-III was substantially lower than the pass rate among students who actually sat the examination, ranging from approximately 10% to 21% during 2001-2011 (MOE, 2013). This distinction is crucial because a school can raise its apparent pass rate partly by entering only students considered likely to succeed. Conversely, broadening examination access may temporarily reduce the percentage passed while increasing the number of students obtaining Mathematics certification. Teacher quality should consequently not be inferred from pass percentages without considering examination-entry practices. A historically robust analysis must distinguish success among candidates from mathematical competence across the entire age cohort.

This issue also complicates comparisons among schools. Highly selective schools may begin with students who performed strongly in primary education, while non-selective schools may educate cohorts with much weaker initial mathematics proficiency. Raw CSEC pass rates therefore combine school contribution with substantial differences in prior attainment. The JETC (2021) recommended greater attention to value-added measures precisely because absolute examination results can misrepresent institutional effectiveness where schools serve different student populations. The same principle should be applied to teachers because a teacher improving students from very low initial proficiency to near-pass performance may be highly effective despite modest final examination results. Jamaica requires value-added mathematics measures if teacher quality is to be assessed fairly.

Evidence that Teacher Support Can Change Outcomes

School-level interventions provide important counter-evidence against deterministic accounts of Jamaican mathematics failure. Following very weak CSEC results in 2004, selected schools implemented structured mathematics-training and instructional modules accompanied by teacher development. Jamaica College, St George's College, St Hugh's High, Meadowbrook, Gaynstead and Mona High were among institutions participating in early intervention arrangements (JIS, 2011). At Meadowbrook, the reported mathematics pass rate rose from approximately 21.7% in 2004 to more than 70% later in the decade, while Gaynstead similarly recorded substantial improvement from a low starting point (JIS, 2011). Although these are not randomised experiments and cannot isolate teacher training from other simultaneous changes, they demonstrate that school-level Mathematics outcomes can shift dramatically under sustained intervention. The evidence therefore supports investment in teacher development while cautioning against assuming that one intervention will generalise automatically to every school.

National trends during 2012-2015 offer a second important example. CSEC Mathematics passes increased for three consecutive years during a period in which the Ministry deployed mathematics specialists and coaches and expanded in-service support (JIS, 2016). The improvement from approximately 42% to 62% was sufficiently large to demonstrate that national performance can respond to coordinated interventions. However, the subsequent decline

reinforces the central gap identified by this paper: Jamaican research has insufficiently explained why effective improvement mechanisms fail to become self-sustaining. If specialist coaching increases achievement while coaches are present, the system must determine how those practices become embedded permanently in ordinary mathematics departments. Sustainable teacher quality requires institutionalisation rather than recurring rescue programmes.

Mathematics Coaches and Professional Development

Mathematics coaching represents one of Jamaica's most sustained attempts to improve teacher practice without waiting for the entire teaching workforce to be replaced. Coaches observe lessons, provide feedback, conduct demonstration teaching, support planning and facilitate professional development in schools (JIS, 2019). This model aligns with evidence that professional development is most effective when it is subject-specific, sustained, connected to classroom practice and supported through professional collaboration. Coaching also allows teachers without full specialist preparation to strengthen mathematical pedagogy while remaining in the classroom. However, coach coverage has historically reached only a portion of Jamaican schools, limiting the intervention's system-wide intensity. The model consequently raises questions about scale, duration and the transfer of coaching expertise into permanent school-level capacity.

Professional development must also address mathematics content rather than pedagogy alone. Crossfield and Bourne (2017) identified limited professional development and inadequate mathematics specialisation as distinct but interacting deficiencies. Teachers cannot teach conceptually what they themselves understand only procedurally, meaning that training must include substantive mathematics alongside instructional strategies. Professional learning communities could allow teachers to analyse CSEC items, compare student errors, study mathematical reasoning and jointly design instructional sequences. Heads of mathematics departments require equivalent development because instructional leadership influences whether new practices survive beyond workshops. Jamaica's next stage of reform should therefore move from professional-development events towards permanent mathematics-learning organisations in schools.

The Pandemic as an Exogenous Shock

The COVID-19 pandemic created an exceptional disruption superimposed on longstanding structural weaknesses. School closures, remote instruction, unequal digital access and reduced opportunities for direct teacher-student interaction affected learning internationally, but mathematics may have been particularly vulnerable because cumulative concepts often require continuous guided practice. Jamaica's pass rate declined from 61.2% in 2020 to 38.2% in 2021, although examination arrangements and cohorts during this period complicate direct causal interpretation (JIS, 2021). The decline cannot plausibly be interpreted as evidence that mathematics teachers suddenly became substantially less competent in one year. Instead, it illustrates how student outcomes can shift dramatically when the instructional environment changes even if formal teacher qualifications remain similar. This provides additional evidence that teacher quality should be analysed in a wider educational system.

The post-pandemic period also demonstrates the persistence of learning recovery challenges. Mathematics performance remained weak in 2024 and improved only modestly to 44% in 2025, still below the 2019 level of approximately 54% (MESYI, 2025). Such results suggest that pandemic learning loss interacted with pre-existing weaknesses rather than creating a wholly new problem. Students who lost foundational instruction subsequently advanced into more difficult mathematics courses, transferring learning deficits through the education pipeline. Teachers therefore encountered cohorts requiring greater remediation at precisely the time when teacher recruitment and retention were also under pressure. Post-pandemic mathematics recovery consequently demands long-term intervention rather than interpretation as a temporary examination anomaly.

The Contemporary Teacher-Quality Crisis

The contemporary evidence suggests that Jamaica has improved the general academic qualifications of its teacher workforce while continuing to face subject-specific shortages. The JETC (2021) identified Mathematics and Science among the areas experiencing a critical shortage of quality teachers and linked teacher attrition directly to the problem. This distinction is important because a highly credentialed national teacher workforce can coexist with significant shortages in specialist STEM disciplines. Mathematics teachers possess skills valued outside education and are internationally mobile, making retention particularly difficult. Schools may consequently fill vacancies with individuals whose overall teaching credentials satisfy general requirements but whose mathematics specialisation remains limited. The contemporary quality problem is therefore increasingly about **specialist alignment and retention**, not merely possession of tertiary qualifications.

The Ministry's continuing interventions reinforce this diagnosis. In 2024, following a 39% public-school Mathematics pass rate, education authorities reported that they were examining the pool of educators teaching Mathematics and developing strategies to strengthen teacher support (JIS, 2024). In 2025, the Education Minister described Jamaica as experiencing a "crisis of mathematics" and welcomed international and domestic collaboration intended to strengthen mathematics instruction (MESYI, 2025). The repetition of similar policy concerns across decades demonstrates that the central research problem is not failure to recognise teacher quality as important. The unresolved problem is why specialist teacher capacity has not yet reached sufficient depth, stability and equitable distribution to transform national outcomes permanently.

Teacher Quality versus Teacher Blame

A major contribution of this study is the distinction between **teacher quality** and **teacher blame**. Teacher quality is a legitimate research construct encompassing knowledge, pedagogy, professional judgement, qualifications and instructional effectiveness, whereas teacher blame attributes complex system outcomes primarily to individual educators. The latter perspective ignores the role of government in teacher supply, universities in initial preparation, school leaders in deployment, labour markets in migration and earlier educational stages in producing students' foundational knowledge. Crossfield and Bourne's (2017) findings themselves demonstrate this complexity because teacher-related factors appeared alongside socioeconomic conditions,

parental involvement, leadership, student preparation, working conditions and instructional resources. Teacher performance is therefore partly shaped by the system in which teachers work. A scholarly explanation must hold teachers professionally accountable without turning them into convenient explanations for failures created across multiple institutions.

The distinction also has implications for reform. Policies that repeatedly send teachers to short workshops while leaving staffing shortages, large learning gaps and weak departmental structures unchanged may produce limited long-term effects. Conversely, focusing exclusively on salaries and working conditions without strengthening mathematical knowledge and pedagogy would leave important instructional weaknesses unresolved. Teacher quality reform therefore requires simultaneous attention to recruitment, preparation, certification, professional learning, school leadership, deployment and retention. The policy unit should be the **mathematics teaching system**, not the isolated teacher. This systems approach directly addresses the research gap created by fragmented explanations of Jamaican CSEC performance.

A Four-Decade Interpretation

Viewed across approximately four decades, Jamaica's Mathematics performance demonstrates persistence without complete immobility. Low outcomes in the 1980s and 1990s continued into the early 2000s, suggesting that the contemporary problem has deep institutional roots rather than being created by recent curricula or the pandemic. The improvement periods of the late 2000s and particularly 2012-2015 demonstrate that effective interventions can alter achievement substantially. However, subsequent declines suggest that the gains were insufficiently institutionalised or were disrupted by teacher attrition and other system pressures. The pandemic magnified these vulnerabilities but cannot explain their historical origin. Jamaica's national mathematics dilemma is therefore best characterised as **chronic weakness punctuated by reversible improvement**.

Teacher quality fits this historical pattern better when conceptualised as a changing institutional capacity than when conceptualised as a fixed characteristic of Jamaican teachers. The number and distribution of specialists can increase through scholarships and training, then decline through migration or retirement. Professional development can improve instructional practice, but new teachers entering departments may not possess the same preparation unless institutional routines transfer that knowledge. Coaching can produce improvement in targeted schools without transforming national teacher preparation at scale. Leadership changes can similarly strengthen or weaken mathematics departments even where individual teachers remain. Mathematics-teacher quality must therefore be understood as a stock of human and institutional capital that Jamaica can accumulate, lose and rebuild.

Mathematics Teacher Quality-Achievement Continuum

The findings support a six-stage continuum explaining how teacher-related factors influence CSEC outcomes. The first stage is **recruitment quality**, which concerns whether mathematically capable candidates enter teacher education rather than higher-paying alternative careers. The second is **preparation quality**, encompassing university-level mathematical depth, mathematics

pedagogy and supervised classroom experience. The third is **deployment quality**, referring to whether specialists are actually assigned to the grades and courses for which they were prepared. The fourth is **instructional quality**, encompassing explanations, assessment, reasoning, differentiation and responsiveness to student misconceptions. The fifth is **professional sustainability**, including coaching, departmental leadership, professional learning and retention, while the sixth is **student mathematical outcomes**, culminating in CSEC knowledge, comprehension and reasoning.

Failure at one stage can reduce the effectiveness of later stages. Strong teacher education produces limited national benefit if graduates migrate before developing sustained careers in Jamaican schools. Effective deployment cannot compensate completely for weak foundational student knowledge, while strong content knowledge cannot generate high achievement if teachers lack pedagogical skill. Likewise, intensive CSEC preparation in Grade 11 cannot fully repair years of weak mathematical learning beginning in primary school. The continuum consequently shifts reform attention from isolated interventions towards alignment across the teacher-development pipeline. Sustainable CSEC improvement requires continuity from teacher recruitment to student examination performance.

Policy Recommendations

The first policy priority should be universal access to appropriately specialised Mathematics teachers at the secondary level. Jamaica should establish a publicly reported annual Mathematics Teacher Capacity Index showing the number of teachers, mathematical qualifications, grades taught, school location, years of experience, vacancies and annual attrition. This would allow government to distinguish nominal teacher coverage from genuine specialist coverage and identify schools where students are taught repeatedly by out-of-field teachers. Targeted scholarships should continue but should be connected to retention incentives and carefully designed service agreements where public funding substantially finances teacher preparation. Rural and hard-to-staff schools should receive additional incentives because increasing the national supply without improving distribution will preserve educational inequality. Teacher-workforce planning should therefore become as data-intensive as student examination reporting.

The second priority is strengthening mathematical knowledge for teaching. Initial teacher-education programmes should assess prospective mathematics teachers' content knowledge at entry, during preparation and before graduation rather than assume that course completion establishes mastery. Teachers already in the system should have access to modular mathematics-content upgrading in algebra, geometry, probability, statistics and mathematical reasoning alongside pedagogy. Professional development should use authentic student misconceptions and CSEC reasoning tasks rather than rely principally on general instructional theory. Mathematics coaches should increasingly develop school-based teacher leaders capable of sustaining coaching functions when external support ends. The objective should be to create mathematically knowledgeable departments rather than isolated strong teachers.

The third recommendation concerns foundational mathematics. Jamaica should establish a longitudinal numeracy-monitoring system linking primary assessments to secondary intervention

so that Grade 7 teachers receive meaningful diagnostic information about incoming students. Students entering secondary school with serious deficits should receive sustained intervention before those deficits become embedded in CSEC courses. Specialist mathematics support should therefore begin earlier than Grade 10 and Grade 11. Primary teachers also require stronger mathematical preparation because secondary specialists cannot continually compensate for weak foundations created in earlier schooling. A national mathematics strategy must treat the educational journey as one continuous system from early childhood through CSEC.

The fourth recommendation concerns professional retention. Mathematics and science teachers should receive targeted incentives reflecting the scarcity and external market value of their specialist competencies, especially where shortages demonstrably threaten educational access. Incentives need not be salary alone and could include funded postgraduate education, accelerated professional advancement, research opportunities, housing support in difficult locations and reduced administrative burdens for high-performing classroom specialists. Department heads should receive specialised instructional-leadership preparation because their role in mentoring teachers and coordinating curriculum is central to institutional continuity. Returning diaspora teachers could be recruited through structured short- and long-term programmes, including virtual mentoring where appropriate. Jamaica cannot sustainably improve Mathematics while continuously exporting large proportions of the expertise it develops.

Discussion

The evidence supports a qualified teacher-quality explanation of Jamaica's four-decade Mathematics dilemma. Jamaica has repeatedly experienced insufficient numbers of fully qualified mathematics specialists, and empirical research identifies certification, specialisation and professional development as relevant to CSEC achievement (Crossfield & Bourne, 2017). Ministry evidence additionally shows that periods of improvement have coincided with mathematics coaching, specialist deployment and targeted instructional support (JIS, 2016, 2019). These patterns make it implausible to argue that teacher quality is unrelated to national outcomes. However, the same evidence makes it equally implausible to attribute low pass rates to teacher quality alone because changes in student cohorts, foundational knowledge, examination entry, school conditions and exogenous shocks also matter.

The principal literature gap is therefore not simply the absence of more research on teachers. Jamaica already possesses studies demonstrating that teacher-related deficiencies affect mathematics learning, reports documenting examination weakness and policies specifying teacher standards. The missing contribution is an explanation of **why recognised teacher-quality deficiencies and repeated interventions have coexisted with persistent national underachievement for decades**. This study argues that the answer lies in the failure to accumulate and retain mathematics-teaching capacity sufficiently across the whole system. Training improves the stock, migration depletes it, coaching strengthens practice locally, unequal deployment distributes expertise unevenly, and weak foundational learning continuously increases the remedial burden placed on secondary teachers. The mathematics dilemma persists because improvements in one component are repeatedly offset by weakness elsewhere in the continuum.

This interpretation also explains the remarkable 2012-2015 improvement without treating it as contradictory evidence. The rise to approximately 62% demonstrates that student achievement responds to coordinated system effort and therefore rejects culturally deterministic claims that Jamaican students are intrinsically weak in Mathematics. The subsequent fall suggests that improvement did not become sufficiently resilient to teacher attrition and other changing system conditions. Reform should therefore investigate the organisational characteristics of the 2012-2015 improvement period in much greater detail, including staffing, coaching intensity, examination participation and school-level variation. Identifying the mechanisms responsible for that improvement may be more valuable than repeatedly designing wholly new interventions. A learning education system should preserve knowledge of what previously worked and why.

Limitations

The principal limitation is the absence of one fully harmonised four-decade dataset linking individual teachers with individual students and CSEC outcomes. Historical pass-rate statistics differ in candidate coverage and reporting conventions, making exact annual comparisons difficult across the entire period. Formal qualifications additionally provide incomplete measures of teacher quality because they cannot directly reveal pedagogical effectiveness or mathematical reasoning. The study therefore cannot estimate the proportion of CSEC underachievement causally attributable to teachers compared with students, families, schools or other factors. Historical coincidence between teacher interventions and examination improvement should similarly not be interpreted as causal proof. The analysis instead establishes a theoretically grounded and empirically supported explanation requiring more rigorous longitudinal testing.

Future research should construct teacher-student linked longitudinal data covering qualifications, specialisation, years of experience, professional development, school characteristics, prior student achievement and subsequent CSEC performance. Multilevel modelling could then estimate teacher and school effects while controlling for student intake and socioeconomic background. Value-added analysis would be particularly useful in Jamaica because raw pass rates strongly favour schools enrolling already high-achieving students. Research should also compare teachers who satisfy the National Mathematics Policy's full specialist requirements with out-of-field teachers after controlling for school and student characteristics. Qualitative classroom observation could complement this analysis by examining whether formal specialist credentials translate into conceptual and reasoning-oriented instruction. Such research would provide a substantially stronger causal test of the teacher-quality hypothesis than national pass-rate comparisons alone.

Conclusion

Four decades of Jamaican CSEC Mathematics evidence reveal a national education problem that is persistent, consequential and yet demonstrably capable of improvement. Low pass rates appeared long before the contemporary period, remained severe through portions of the 1990s and early 2000s, improved markedly during selected periods and subsequently declined again. Teacher quality forms an important part of this history because Jamaica has repeatedly lacked sufficient fully qualified mathematics specialists and has simultaneously experienced significant

migration of mathematics and science teachers. Yet CSEC results do not constitute direct teacher evaluations because achievement reflects cumulative primary preparation, school resources, socioeconomic conditions, examination participation, student motivation and instructional opportunity alongside teacher expertise. The evidence therefore rejects both the proposition that teachers are irrelevant and the proposition that teachers alone explain the crisis. Jamaica's challenge is systemic precisely because mathematics teaching quality is produced through recruitment, preparation, deployment, professional support and retention.

The current research gap is best understood as a failure to connect these elements longitudinally. Existing studies explain important parts of the problem, but a four-decade perspective demonstrates that Jamaica has repeatedly repaired individual components without producing a sufficiently stable mathematics-teaching system. The proposed Mathematics Teacher Quality-Achievement Continuum explains why short-term interventions can improve outcomes but fail to generate enduring transformation when specialist attrition, unequal deployment and foundational learning deficits continue. Sustainable reform therefore requires more than additional workshops, curriculum revisions or public concern following the annual publication of CSEC results. Jamaica must develop and retain a critical mass of mathematically knowledgeable and pedagogically capable teachers while ensuring that students encounter strong mathematics teaching throughout the entire educational pipeline. The real measure of reform will be reached when high-quality mathematics instruction becomes an ordinary entitlement of every Jamaican child rather than a resource disproportionately available in selected schools.

References

- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407. <https://doi.org/10.1177/0022487108324554>
- Crossfield, D., & Bourne, P. A. (2017). Education professionals' perceptions of factors that contribute to effective mathematics teaching and achievement in Jamaica. *International Journal of Research in Humanities and Social Studies*, 4(12), 1-10.
- Darling-Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Education Policy Analysis Archives*, 8(1), 1-44. <https://doi.org/10.14507/epaa.v8n1.2000>
- George, L. (2023). Investigating large-scale, high school mathematics achievement through the lens of the cognitive domains. *Electronic Journal for Research in Science & Mathematics Education*, 27(3), 35-63.
- Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, 42(2), 371-406. <https://doi.org/10.3102/00028312042002371>
- Jamaica Education Transformation Commission. (2021). *The reform of education in Jamaica, 2021 report*. Government of Jamaica.
- Jamaica Information Service. (2011). *Schools reporting high math passes from use of training module*. Government of Jamaica.

- Jamaica Information Service. (2014). *Improved performance by CSEC students*. Government of Jamaica.
- Jamaica Information Service. (2015). *More students pass CSEC Mathematics*. Government of Jamaica.
- Jamaica Information Service. (2016). *Minister of Education's statement to Parliament on mathematics in the public education system*. Government of Jamaica.
- Jamaica Information Service. (2017). *Improved pass rates for 18 of 34 subjects in CSEC*. Government of Jamaica.
- Jamaica Information Service. (2018). *Increase in CSEC pass rate for public school students*. Government of Jamaica.
- Jamaica Information Service. (2019). *More math specialists for primary schools*. Government of Jamaica.
- Jamaica Information Service. (2021). *Specialist teachers for primary and secondary schools*. Government of Jamaica.
- Jamaica Information Service. (2022). *Improved performances in several CSEC and CAPE subjects*. Government of Jamaica.
- Jamaica Information Service. (2024a). *Improvement in PEP exam results*. Government of Jamaica.
- Jamaica Information Service. (2024b). *Jamaican students perform marginally higher in 2024 CSEC Mathematics exam*. Government of Jamaica.
- Ministry of Education, Skills, Youth and Information. (2025). *Improved performance in 2025 CSEC English and Maths*. Government of Jamaica.
- Ministry of Education, Youth and Information. (2016). *Improved passes in 13 CSEC subjects*. Government of Jamaica.
- Ministry of Education. (2013). *National Mathematics Policy Guidelines*. Government of Jamaica.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14. <https://doi.org/10.3102/0013189X015002004>
- World Bank. (2000). *Caribbean education sector study*. World Bank.